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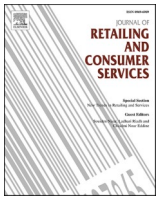

From the store to the kitchen: Herbal scents drive wholesome food choice

Megan Phillips [a,*], Sommer Kapitan [a], Elaine Rush [b]

[a] School of Business, Auckland University of Technology, Auckland, 1142, New Zealand
[b] School of Sport and Recreation, Auckland University of Technology, Auckland, 1142, New Zealand

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ABSTRACT

As retail adopts more use of scent to sell, this paper explores whether an herbal scent can be used to prime wholesome food choices. The results of two laboratory experiments (physical and online) and one field experiment show that the presence of an herbal scent (vs. non-herbal or no scent) – specifically a mixed herb odor – increases selection and purchase of wholesome foods. This is due to semantic associations created through repeated exposure to the smell of culinary herbs widely employed in global cuisines and everyday home cooking. Specifically, exposure to herbs (vs. no scent) activates associations to cooking and home-cooked meals, which in turn motivates consumers to select more wholesome ingredients to create a meal at home. The results of this research extend findings in olfactory congruence in marketing and ambient scents in retail to enhance understanding of the role of retail atmospherics in influencing food choice and sales. This research provides further implications of scent in retail settings for consumer health and well-being.

1. Introduction

Can the right smell increase choice and sales of nutritious whole foods? Supermarket retailers already use artificial scent strategies to encourage spending. For instance, a supermarket in Brooklyn releases odors of grapefruit in the produce section, chocolate in the confectionary aisle and rosemary focaccia by the bakery (Johnson, 2011), while grocery stores in Chicago and New Jersey release cheesecake smells to inspire baking at Easter (Moran, 2022). Scholarship around olfactory congruence show two key reasons why such retailers can be effective: (1) because scents that match their retail setting are processed more fluently and affectively (Lunardo, 2012; Leenders et al., 2019) and (2) because the associated scent positively influences spending, choice behaviour and decision-making (Errajaa et al., 2020; Esteky, 2021; Stocchi et al., 2021). Yet scholars are still probing how to drive increased choice of products that drive health outcomes (Stocchi et al., 2021; Otterbring and Shams, 2019).

In this paper, we ask: what if an herbal scent (e.g., mixed herbs) was released in the store? Would it cue shoppers to think about home-cooking and thus make more wholesome choices? Wholesome food choices relate to the selection and preference for fresher, more nutritiously complete, natural, and minimally processed foods. These choices prioritize a diverse range of products and categories, including meat, vegetables, whole grains, legumes, fruits, nuts, and seeds (Bublitz et al., 2013; Eskine, 2013; Esteky, 2021; Gellynck et al., 2006). The present research seeks to investigate how exposure to an herbal scent affects behavioural outcomes such as this kind of wholesome food choice, along with managerially relevant outcomes such as sales.

Scent marketing has been shown to influence human emotions, memories, and motivations (Krishna et al., 2014). This is because of the direct link between the olfactory bulb, the olfactory tract, and the limbic system— the part of the brain that is responsible for memory— and behavioural and emotional responses (Orth and Bourrain, 2008). When odors are processed and retrieved, they activate semantic associations between odors and sensory knowledge (De Luca and Botelho, 2020). That means there can be significant olfactory and behavioural effects due to semantic associations (i.e., Holland et al., 2005; Leenders et al., 2019; Spangenberg et al., 2006; Stocchi et al., 2021), which drive choice of certain foods (i.e., Esteky, 2021; Gaillet et al., 2013; Gaillet-Torrent et al., 2014). Although prior research has investigated the use of ambient food and non-food scents from fruity (i.e., citrus), savory, indulgent (i.e., cookies, pizza, chocolate ice cream) and warmer (i.e., cedarwood) scents in driving food choices (i.e., Biswas and Szocs, 2019; Chae et al., 2023; Gaillet et al., 2013; Lefebvre and Biswas, 2019), and healthier food choice (Biswas and Szocs, 2019; Chae et al., 2023; Lefebvre and Biswas, 2019), research has yet to show whether an herbal scent can prime wholesome food choices and sales. Despite the recent advancements of olfactory research, there is still much marketing and retail scholars do

* Corresponding author.
E-mail address: mphillip@aut.ac.nz (M. Phillips).

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not know.

Practically, understanding how scents influence consumer responses to foods in a supermarket setting is relevant because more than 1.9 billion adults and 41 million children under age 5 are overweight or obese (WHO, 2018). Given supermarkets are pivotally positioned between shoppers and the foods they consume, understanding this relationship might help nudge consumers to make more wholesome choices, and thus influence the foods they are consuming (Stocchi et al., 2021). Companies invest millions of dollars into scent marketing efforts (Ragavan, 2021); therefore, it is critical to provide theoretically driven insights into the potential influences of different scent types.

The aim of the present study is to examine: 1) to what extent shopper wholesome food choices increase when an herbal scent such as mixed herbs is present and 2) whether a home-cooking concept is the driver of this effect. We expect that an herbal scent (vs. non-herbal scent in study 1 or vs. unscented condition in studies 2 and 3) forms a cue that yields increased choice and purchasing of wholesome foods. Consistent with congruency theory (Bone and Ellen, 1990; Mandler, 1982) and semantic congruency (Krishna et al., 2010), we further theorize and test how the effect might be driven by a triggering of an associated and congruent home-cooking association cued from memory and semantic association, which motivates increased choice of wholefood ingredients to make a meal or fix food at home. We contribute to efforts to build a more unified olfactory theory in consumer behaviour (see Madzharov et al., 2015) by establishing when and why scent that differs on semantic meanings related to home-cooking influence choice behaviour. We build on scent congruency and semantic congruency literature that shows congruency between the semantic meaning of a scent and behaviour (i.e., Bone and Ellen, 1990; Holland et al., 2005; Krishna et al., 2010; Madzharov et al., 2015; Spangenberg et al., 2006). Next, we explore the theoretical background.

2. Theoretical background and hypothesis development

2.1. Herbal scent

The exploration of herbal scents in marketing and retail is relatively uncharted territory. Herbal scents encompass a range of odors derived from various plants valued for their aromatic, culinary, medicinal, and/or therapeutic properties (Stefanaki and van Andel, 2021; Tapsell et al., 2006). Aromas from herbs such as coriander, lavender, basil, garlic, mint, thyme, sage, lemongrass, cinnamon, and chamomile – to name a few – are notably diverse.

Given the widespread use of herbs in products like perfumes, essential oils, candles, and skincare – particularly in practices like aromatherapy – and in culinary pursuits, there exists a potential spectrum of associations for individuals encountering herbal aromas. Previous research indicates that herbal scents are pleasant (Esteky, 2021) and may be linked to a sense of freshness (Adams and Doucé, 2017). Additionally, these scents could evoke associations with experiences such as being in nature or in a garden, cooking in the kitchen, enjoying herbal teas, encountering perfumes, using cosmetics, or even medicinal products.

Given the diverse array of herbal aromas, we focus on culinary herbal scents, specifically mixed herbs. Culinary herbs play an integral role in cookery, bakery, food preservation, and flavor enhancement, widely employed in global cuisines and everyday home cooking practices (Stefanaki and van Andel, 2021). For instance, basil enhances the flavor of tomato and salad dishes, chives contribute to salads and cold soups, oregano elevates spaghetti, freshly made sauces, soups, salads, homemade pizza and chicken dishes. Dill complements cold soups, salads, and cooked vegetables, thyme imparts its essence to sausages, stuffing, stews, soups, and cooked vegetables, while parsley adds a finishing touch to vegetables, stews, and soups. In French cuisine, the combination of herbs forms the cornerstone of good cooking. Common blends often used in cooking include thyme, rosemary, oregano, and basil, resulting in a complex and aromatic scent that combines the distinct fragrance of each herb. Our research focuses on mixed herbs, specifically within the culinary scent realm, as this is expected to align well in a supermarket retail food setting (Leenders et al., 2019; Lunardo, 2012). This decision is anticipated to fit and be congruent with the diverse food categories available in fresh food departments especially in Western supermarkets, where wholesome foods are typically offered.

2.2. Herbal scents and semantic associations

There is reason to believe that an herbal scent such as mixed herbs can activate associations to home-cooked meals and home cooking. This is because repeated exposure to a scent and the accompanying experiences can form strong associations (Orth and Bourrain, 2008) including through repeated exposure to the smell of culinary herbs widely employed in global cuisines and everyday home cooking (Stefanaki and van Andel, 2021). Orth and Bourrain (2008) show that ambient scents can evoke nostalgia in the marketplace, which can influence related behaviours, particularly when the cues drive accessibility of a shopper's memory. Learned associations through the smelling, creation, and consumption of foods with culinary herbs are likely to develop semantic associations between culinary herb scent and home-cooking.

Prior research shows that when odors are perceived, semantic associations between the odor and previously stored sensory knowledge can become activated, and subsequently influence behaviour (Holland et al., 2005; Leenders et al., 2019; Spangenberg et al., 2006). For instance, when participants were exposed to a citrus scent, the behavioural concept of cleaning was triggered, which lead to more cleaning during an eating task compared to participants who were not exposed to the scent (Holland et al., 2005). In the food domain, participants primed with a fruity scent (i.e., melon, pear) activated a fruit and vegetable concept, which encouraged more choice of starters and desserts with vegetables and fruit (Gaillet-Torrent et al., 2014; Gaillet et al., 2013). Consequently, we propose that exposure to a mixed herb (vs. no scent) activates the concept of home-cooking and associations to home-cooked meals, which in turn influences consumer behaviour.

2.3. Semantic congruency and choice behaviour

We anticipate the impact of herbal scent on preference and choice behaviour to be additionally driven by semantic congruence. Semantic congruence refers to the extent of fit of the semantic associations among the characteristics (Krishna et al., 2010). Building on prior literature, we focus on the congruence between the semantic meaning of a scent and corresponding products and behaviours (see Holland et al., 2005; Spangenberg et al., 2006, for examples). For instance, previous studies show that diffusing a chocolate scent in a bookstore led to increased approach and goal-directed behaviour with thematically congruent products (Doucé et al., 2013). Similarly, the presence of a natural scent in a store boosted spending on natural products (Esteky, 2021). Furthermore, gender-specific scents semantically related to a retailer's product offerings significantly influenced consumer behaviour towards congruent products (Spangenberg et al., 2006). Given that the scent of mixed herbs is a food aroma, we expect it will drive consumers to increase their choice and purchasing of congruent wholesome foods. This expectation is supported by prior research showing that food aromas can enhance congruent appetite, saliva production, and the selection of congruent foods (i.e., Gaillet et al., 2013; Morquecho-Campos et al., 2020; Proserpio et al., 2017; Zoon et al., 2016).

We also propose that semantic congruence helps to explain why associations with the concept of home-cooking can shape specific behaviours aligned with making a home-cooked meal, thus driving more wholesome food choices. Specifically, the semantic associations evoked by mixed herbs are likely to heighten the desire for a home-cooked, wholesome meal. Learned associations to the smell of culinary herbs commonly used in everyday home cooking (Stefanaki and van Andel,

2021), along with the accompanying experiences (Orth and Bourrain, 2008) such as interactions with various wholesome ingredients used in meal preparation, can help form strong associations between herbs and home-cooking. Thus, the smell of herbs can activate a home-cooking concept and the accompanying experiences, subsequently motivating consumers to select and purchase related ingredients for such a meal.

Such research leads to the prediction that a culinary herbal scent such as mixed herbs can prime the concepts of home-cooking and influence choice of congruent wholesome foods. The conceptual framework is depicted in Fig. 1.

We define wholesome foods as being fresher, more nutritiously complete, and natural, minimally processed foods that include meat, vegetables, whole grains, legumes, fruits, nuts, and seeds (Bublitz et al., 2013; Eskine, 2013; Esteky, 2021; Gellynck et al., 2006). Wholefoods are considered healthier than shelf-stable options or processed packaged foods, which can have higher levels of sodium, sugar, oils, fat and/or preservatives (Monteiro et al., 2019; Stocchi et al., 2021). We formally predict.

H1. Exposure to an herbal scent (mixed herbs) vs. no scent or a non-herbal scent (bakery) leads to increased choice and purchase of wholesome foods.

H2. The effect on choice is mediated by associations with a home cooking concept.

3. Study 1: A virtual supermarket test of ambient herbal (vs. Non-herbal) scent

Study 1 examined experimentally whether an ambient herbal scent (i.e., mixed herbs) vs. non-herbal scent (i.e., bakery) will encourage shoppers to purchase more wholesome baskets of foods. We sought to determine which scent led to increased purchase of wholesome foods, defined as fresh, more nutritionally complete, and minimally processed whole foods with healthier ratings (Ministry of Health, 2015).

3.1. Design and procedure

Participants for this experimental study (N = 214, M_{age} = 32 y, female = 72%) were recruited from the wider community and invited to undertake a grocery-shopping trip in a virtual supermarket (Fig. 2) in a university consumer behaviour laboratory. Participants were recruited through a convenience sample from the ethnically diverse populations of Auckland, New Zealand. Recruitment was via posters, emails, and both paid and unpaid social media advertisements on platforms such as LinkedIn, Facebook and Instagram. Verbal promotion also took place in postgraduate and undergraduate classes. During the recruitment process, individuals were screened and excluded from the research if they specified allergies, sensitivity to scents, or asthma. Inclusion criteria encompassed individuals aged 18 years and over, those who were

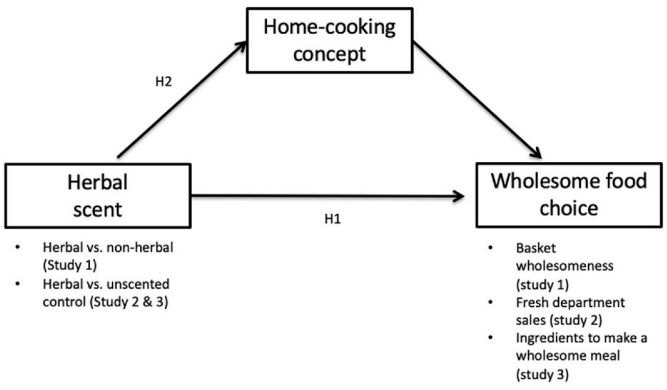

Fig. 1. Conceptual framework.

grocery purchasers, and those able to visit the laboratory. The sample largely mirrored the major ethnic groups identified by Statistics New Zealand in 2018. In the present study, 68.9% identified as New Zealand/European (compared to 70.2% in StatsNZ, 2016), 22.7% as Asian (compared to 15.1% in StatsNZ, 2016), 11.4% Māori (compared to 16.5% in StatsNZ, 2016), 7% Pacific people (compared to 8.1% in StatsNZ, 2016), 4.1% as Middle Eastern, Latin American and African (compared to 1.5% in StatsNZ, 2016), and 1.4% identified as other ethnicity (compared to 1.2% in StatsNZ, 2016). One participant was excluded from the analysis as they guessed the hypothesis.

The virtual supermarket was modeled on a local supermarket with all prices and products obtained through a field survey of online and in-store pricing (Waterlander et al., 2015, 2016). There were 1412 products available in the store from 18 food groups across 91 categories (see Waterlander et al., 2015, for an explanation). The virtual environment allowed experimental control of other environmental factors that could influence food choices such as pricing, promotions, crowding, music, and lighting. Participants accessed the virtual store through a desktop computer.

Participants were randomly assigned to one of two scent conditions (herbal: mixed herbs vs. non-herbal: bakery) in a between-subjects experimental design. The ambient scents were physically experienced via two unobtrusively placed AromaStreamer 300 scent machines (Reima Air Concept, Chemnitz, Germany) installed in the lab. The scent supplier describes the mixed herb scent as "an aromatic and appetizing mix of herbs and spices" and the bakery scent as "fresh bread rolls, freshly-baked cakes and further sweet pastries refine this crispy bakery scent" (Reima Air Concepts, https://www.duftmarketing.de/en/our-scents.html).

A stringent odorization procedure was defined by trial runs within the lab to ensure optimal scent intensity consistent across conditions (Doucé and Janssens, 2013; Leenders et al., 2019). We set the level at which point people were initially unaware of the scent but when the researcher focused their attention on it, they were able to detect it. Ensuring the scent was detectable (Schifferstein and Blok, 2002) but not explicitly noticed (Leenders et al., 2019) was important for ensuring the scent was not too intense, yet subtle enough to be perceived and influence behaviour. The diffuser was filled with 10 squirts of liquid scent 30 min before the beginning of each day, following which it was refilled every hour (after each group of participants had finished). Scenting the laboratory 15–30 min before a session and replenishing the scent between groups of participants is a common approach in olfactory research (e.g., Spangenberg et al., 1996; Morrin and Ratneshwar, 2000; Gaillet-Torrent et al., 2014). The fan on the scent machine ran constantly throughout the experimental sessions. The laboratory was fully ventilated between scents. Participants were not aware that the focus of the study was on ambient scent and food choices, and instead, a cover story suggested that we were testing the usability of a virtual store environment. Participants were fully debriefed at the conclusion of the study.

Before beginning the experiment in the laboratory, participants were asked to select six pre-determined products from around the store to familiarize them with the virtual supermarket on the computer. During this time, participants were exposed to the ambient scent for a duration of 10 min before completing the target virtual shop. The main experimental task asked each participant to complete a typical shopping trip for 3 days' worth of groceries (two weekdays and one weekend day; as suggested by Gibson, 2005) while sticking to a self-reported budget. Participants spent 10–40 min to complete their full shopping trips. They also completed a questionnaire that recorded their demographic information, hypotheses check, and scent awareness and identification. The scent was present for the entire duration that participants were in the laboratory. Full debriefing followed the lab session.

To measure the wholesomeness of the shoppers' virtual food baskets, we applied Ministry of Health (2015) eating and activity guidelines for adults. This guide recommends consuming mostly wholefoods and less processed foods, which include foods low in refined grains, added fat,

Fig. 2. Point of view grocery shopping trip in Study 1's virtual supermarket, with store navigation panel in bottom right-hand corner. The red dot represents shopper's position.

salt and/or sugar (Ministry of Health, 2015). Wholefoods are products closest to their natural state such as fresh vegetables and fruit, raw nuts, fish, chicken, and meat. Less processed foods might have some processing but still retain most of their physical and nutritional properties. These foods include frozen fruits and vegetables, and canned products that are low in sugar or salt such as legumes, beans, and tomatoes (Ministry of Health, 2015). To create wholesome dependent variables, the total number of food items and the total number of those that were wholefoods and less processed foods were tallied for each shopper's virtual basket, and the proportion of wholefoods and less processed foods chosen by the participants was calculated ($wholefoods_{amount}$). As participants spent varying amounts of money, the total number of wholefoods and less processed foods tailed for each shopper's virtual basket was also weighted by total amount spent ($wholefoods_{spend}$). Wholesome categories included fruit and vegetables, meat and seafood, eggs, fruit, and vegetables other.

We also used a nutrition profile scoring to calculate the wholesomeness of the virtual baskets. To do so, we accessed an online calculator available through the Food Standards Australia and New Zealand website at https://npsc.foodstandards.gov.au/to calculate a nutrient profile score for every product in each shopper's virtual basket. Once we had a nutrient profile score for each product, we then added these together to create an overall basket score (see Appendix 1 for examples). As individuals spent different amounts and purchased varying numbers of products, the nutrient profile score for each shopper's virtual basket was then weighted by total number of items purchased ($wholesome_{amount}$) and total basket spent ($wholesome_{spend}$). Nutrient profile scoring is based on the nutrient profiling scoring criterion (NPSC) initially developed by the Food Standards Australia New Zealand for the regulation of health claims (Food Standards Australia New Zealand, 2023). To determine the nutritional composition of a product, its energy, saturated fat, sodium, sugar, fruits, vegetables, dietary fiber, and protein information are entered into an online calculator based on 100g or 100 ml of the product. Less processed wholefoods are considered healthier than processed foods. The health composition of the total basket acted as another DV and measure for grocery basket wholesomeness.

3.2. Results

Manipulation check. Participants were asked to indicate whether they noticed a scent in the experimental room. Those in the non-herbal scent condition (58%) were more likely to notice a scent compared to those in the herbal scent condition (42%; $\chi^2 = 10.373$, $p < 0.001$). Notably, participants' ability to perceive the scent significantly differed across conditions, hovering around the threshold level of perception (50% intensity) rather than the suprathreshold level (70% intensity), as established in previous research (Leenders et al., 2019; Morrin and Ratneshwar, 2000). This aligns with our intention for the scent conditions to be detectable yet not overly intense, given that stronger scents can reduce priming effectiveness (Smeets and Dijksterhuis, 2014). Although we directed participant attention to the scent when inquiring about their awareness of it, we are unable to determine whether the scents were explicitly noticed during the main study. To do this, we would need to ask participants if they noticed anything different about the laboratory, not directing their attention to the scent. Evidence for this was established in the scenting procedure.

Post-test. A convenience sample (N = 42, M_{age} = 27.21 y, female = 71.4%) of participants described the herbal scent of herbs and spices as being herbal (86.4%) rather than non-herbal (13.6%) and described the non-herbal scent of bakery as being non-herbal (90%) compared to herbal (10%; $\chi^2 = 24.436$, $p < 0.001$). Two independent judges coded participant responses to classify the scent descriptions as herbal or non-herbal (see Appendix 2 for scent descriptions and coding). The inter-judge agreement for the coding of herbal scent type was assessed using Cohen's Kappa resulting in a kappa coefficient of 0.92 (95% CI [0.86, 0.96], indicating substantial agreement among the raters.

Wholesomeness of basket. Amount spent on a basket of groceries did not differ across experimental conditions ($M_{nonherbal}$ = $96.08 vs. M_{herbal} = $87.71; t (1, 213) = 1.032, p = .152). To analyze whether the ambient herbal (mixed herbs) scent rather than the non-herbal (bakery) scent led to increased intention to choose wholesome foods, we conducted multiple independent t-tests, with scent as the between-factor and the wholesome composition of the basket as the dependent variable. In line with our hypothesis (H1), the analysis showed a significant main effect of an ambient herbal scent on wholesome food choices. Participants purchased wholesome baskets of goods (as measured by $wholesome_{amount}$) when an ambient herbal (vs. non-herbal) scent was present ($M_{herb} = -0.44$, $SD = 3.32$ vs. $M_{bakery} = 0.55$, $SD = 3.49$; t (213) = −2.12, p = .036). In terms of $wholesome_{spend}$, participants exposed to an ambient herbal scent purchased marginally more wholesome baskets of goods ($M = -0.15$, $SD = 0.84$) compared to participants exposed to a non-herbal scent ($M = 0.063$, $SD = 0.89$; t (213) = −1.83, p = .07). In terms of $wholefoods_{spend}$, participants exposed to an herbal scent purchased more wholefoods ($M = 0.14$, SD = 0.06) compared to the non-

herbal scent ($M = 0.11$, SD = 0.06; t (213) = 2.43, $p = .013$). In terms of wholefoods$_{amount}$, participants exposed to the herbal scent purchased more wholefoods ($M = 0.55$, SD = .16) compared to the non-herbal scent ($M = 0.47$, SD = .17; t (213) = 3.50, $p < 0.001$).

3.3. Discussion

Study 1 findings show that an ambient herbal (vs. non-herbal) scent yields greater intentions to choose more wholesome foods, showing initial support for H1. The results suggest that if a study participant spent $155 in the virtual supermarket (the average weekly household expenditure on groceries, fruit and vegetables, meat, poultry, fish, and non-alcoholic beverages in New Zealand; StatsNZ, 2016), unobtrusive exposure to an herbal versus non-herbal scent increased the number of wholefoods purchased by 3. This is equivalent to 21 wholefood and less processed items purchased during exposure to an herbal scent, and 18 wholefood and less processed items purchased during exposure to a non-herbal scent, in a grocery order totaling $155. Also, if a participant purchased a total of 12 items, exposure to the scent of herbal scent versus non-herbal scent would increase the average wholesome value of the shopping basket to −4.57 and 6.46, respectively. According to nutrient profile scoring (Ministry of Health, 2015), if the score (−4.57) was for 100g of an individual product it could qualify for a health claim, as it is less than −4. This demonstrates a more wholesome virtual basket of goods when an herbal (vs. non-herbal) scent was present. Small incremental changes in shopper food choice such as those evident in this study are important for individual and public health improvements.

This study extends olfactory priming and congruence research (Errajaa et al., 2020; Gaillet et al., 2013; Lefebvre and Biswas, 2019) showing that when it comes to culinary herbal (vs. non-herbal) scents, wholesome choices are driven by priming effects as fresher, more nutritionally complete wholesome foods seem to be more salient. However, three limitations emerge, both from the virtual and laboratory nature of the study and the scents used. To increase external validity of the findings, Study 2 provides evidence for the phenomenon in the field and further introduces an unscented condition as a control to probe the robustness of the effects observed, and to overcome potentially confounding factors.

Although both scent conditions were perceived at the threshold level of perception, around 50% intensity, and a rigorous odourisation procedure was established and followed to calibrate scent intensity prior to testing, one scent was noticed significantly more than the other. While relative scent intensity is expected to remain reasonably stable due to the standardized scent procedure (Gaillet-Torrent et al., 2014), individual differences in people's ability to perceive the scent may have occurred. Prior research suggests that individuals differ in their sensitivity to odors (Smeets et al., 2008), influenced by factors such as gender (Lundström et al., 2003), genetics (Menashe et al., 2003) and culture (Chrea et al., 2004). Despite randomizing participants to experimental conditions, it is conceivable that the non-herbal scent condition included more olfactory sensitive individuals compared to the herbal scent condition. However, this was not tested. Furthermore, while the non-herbal scent (bakery scent), was perceived as being less herbal, as intended, many participants mentioned its associations with vanilla and sweetness. Although a limitation of this study, sometimes the source of the scent may vary across studies, as shown in previous research. For instance, in Study 1a, Biswas and Szocs (2019) tested the scent of apples (non-indulgent) which is a "sweet" scent and the scent of pizza (indulgent) which is a "savory" scent, then in Study 1b they overcome this limitation by used two scents that were similar in terms of sweetness but differed on indulgence. To address this potential limitation, we intend to incorporate an unscented control condition in Study 2.

4. Study 2: A field test of a culinary herbal scent (vs. No-scent)

Study 1 is the first-known experimental test on the effect of an ambient culinary herbal scent that demonstrated the purchase of wholesome baskets of foods in a virtual supermarket environment. Study 2 serves three purposes. First, it uses a field study to provide external validity and show the practical relevance of an ambient culinary herbal scent on wholesome food choices. This field study enables us to draw more specific conclusions that can be used in retail strategy, including whether retailers should use an herbal scent such as mixed herbs to drive more wholesome choices in their supermarkets. Second, the study extends our investigation to determine whether purchase intent extends to wholesome food choices and sales in a physical supermarket setting. Third, we include an unscented control condition to examine the separate effects of herbal vs. non-herbal scents. The resulting field study is a between-subjects one-factor experimental design (culinary herbal scent vs. unscented control) testing real purchase behaviour.

4.1. Design and procedure

Study 2 was a field experiment conducted in a grocery store belonging to a national supermarket chain and situated as an anchor store in a shopping mall in Auckland, New Zealand. Grocery shoppers who entered the store on the day of data collection participated in a 1-factor (ambient herbal scent vs. unscented) between-subjects design. These conditions were run across two different days, both the same day of the week to control for day of the week effects. Sales data was collected after the scent was present (vs. not present) for one day of operation (Monday) a week apart. The same herbal scent (mixed herbs) from study 1 was used.

Two scent machines (AromaStreamer 300 scent machines, Reima Air Concept, Chemnitz, Germany) were placed unobtrusively behind displays in the fresh food department near the butchery (see Appendix 3), similar to store placement in Leenders et al. (2019) and operated continuously at maximum output for one full day of trading. The butchery department was selected due to its smaller size compared to other departments such as produce. The size facilitated more even dispersion of scent throughout the department. Additionally, the space allowed for discreet placement of scent machines, ensured easy access to electricity for powering the machines, and featured packaged food items, minimizing the risk of scent residues landing on loose and exposed foods. As the store was large (2850sqm) and the scent machines' dispersion was within the fresh food department, we did not expect shoppers to perceive the scent throughout the entire store. The scent intensity was mild as determined by two researchers and store staff.

Point of sales data on the amount sold and total sales for each product in the butchery department was collected from the stores for the day of testing with the herbal scent and the same day a week (Mondays) prior as an unscented control condition. This design allowed us to minimize day-of-the-week effects such as shopper type and sales, as purchasing behaviour usually differs across different days of the week (Gibson, 2005). As the key dependent measures were individual product sales and amount purchased, focusing on the same-day effects allowed us to control for similar levels of sales and foot traffic in the store (Leenders et al., 2019). For the dependent measures, food products were coded based on nutrient profile scores (as in study 1) to determine the wholesomeness of the products sold.

4.2. Results

We examined the effect of the presence of an ambient culinary herbal scent on wholesomeness of items sold. Total product sales did not differ across experimental conditions ($M_{herbal} = 57.07$ vs. $M_{unscented} = 60.70$, t (1, 537) = −1.274, $p = .203$). To analyze whether the ambient herbal scent (mixed herbs) rather than the unscented control led to increased sales of more wholesome foods, we conducted an independent t-test, with scent as the between-factor and the nutrient profile score for each

unit sold as the dependent variable. In line with our hypothesis (H_1), the analysis showed a significant main effect of an ambient herbal scent on increased sales of wholesome foods ($M_{herbal} = 5.16$ vs. $M_{unscented} = 6.49$, t (1, 537) = −1.917, $p <$. 05). The significantly lower nutrient profile score numbers shown the day an herbal food scent was pumped into the store reveals greater purchasing of wholesome foods compared to the unscented control condition.

4.3. Discussion

Results of study 2's field experiment align with study 1 findings and extend to a field context. Specifically, exposure to a culinary herbal scent (vs. unscented control) led to greater sales of wholesome foods in a fresh food department within a supermarket, giving further support for hypotheses 1. This field study supports the power of priming to drive increased choice and actual purchase of wholesome food items cued by a mixed herbs scent (vs. unscented control). As the previous two study results support hypothesis 1, in the next study we examine the phenomenon by identifying a potential underlying mechanism while ruling out possible explanations. Following hypothesis 2, we predict that the effect of a culinary herbal scent drives choice for wholesome foods due to the activation of a home-cooking concept.

5. Study 3: testing home-cooking associations as the underlying mechanism

In the previous studies, participants who were exposed to an herbal scent selected and purchased wholesome foods. The objective of study 3 is to test H2. Specifically, an herbal scent (vs. unscented control) is expected to trigger semantic associations to the home cooking concept, and these in turn are anticipated to drive increased choice of wholesome foods. Importantly, we test a key alternative mechanism, perceived reward, to rule it out from the scent manipulation as a driver of food choice. Previous research indicates its potential as a mediator (Biswas and Szocs, 2019).

5.1. Design and procedure

Prolific workers in the USA (N = 200; female = 53.5%; $M_{age} = 40$) participated in a 1-factor (imagined scent: herbal scent [mixed herbs] vs. unscented control) between-subjects experimental design in exchange for monetary payment. We had participants imagine the odor as opposed to actually experiencing it, as it can yield similar effects on consumer behaviour (Krishna et al., 2014).

Participants read one of the following scenarios:

Herbal scent condition:

"Imagine you walked into your local grocery store to buy food for the weekend. As you enter the store, and you begin browsing the aisles *you notice the smell of aromatic and appetising mix of herbs.* Please take a moment to imagine the *smell.*"

Control condition:

"Imagine you walked into your local grocery store to buy food for the weekend. You enter the store and begin browsing the aisles. Please take a moment to imagine the store."

Participants were then asked to write about their experience as they entered the store to start browsing. The dependent variable, choice between ingredients to make a meal or buy a pre-prepared option, was measured by asking participants: *"Given the choice between buying ingredients for a pasta sauce or buying a pre-made sauce, which one would you choose?"* (1 = "pre-made pasta sauce", and 7 = "ingredients to make own") and *"Given the choice between buying a pre-prepared beef stew with vegetables or buying fresh and raw ingredients to make a beef stew with vegetables, which one would you choose?"* (1 = "definitely buy fresh and raw ingredients", and 7 = "definitely buy pre-prepared"). We choose these food options as they are congruent with a culinary herbal food scent. The mediating variable of an associated home-cooking concept was next measured as a composite score of five items (α = .900). Participants were specifically asked when imagining the in-store shopping scenario, "at that moment, were you thinking about ….", "a meal being prepared at home" (1 = strongly disagree, and 7 = strongly agree), "being in the kitchen cooking" (1 = strongly disagree, and 7 = strongly agree), "consuming a delicious home-cooked meal" (1 = strongly disagree, and 7 = strongly agree), "a freshly prepared meal" (1 = strongly disagree, and 7 = strongly agree), "preparing a meal" (1 = strongly disagree, and 7 = strongly agree). This measure was adapted from Orth et al. (2023). To rule out perceived reward (adopted from Biswas and Szocs, 2019) as an alternative explanation was measured. Specifically, participants were asked to rate the enjoyment (1 = "very low," and 7 = "very high) and pleasantness (1 = "not at all pleasant," and 7 = "very pleasant") of the experience." At the conclusion of the study, participants reported experience with cooking, shopping for groceries, dietary restraint, and demographics.

5.2. Results

Wholesome Choice. Participants who were asked to imagine a herbal scent of mixed herbs (M = 6.47, SD = 2.349) compared to the unscented control group (M = 5.42, SD = 1.996) showed a stronger desire to buy ingredients to make a herby pasta sauce from scratch as opposed to buying a pre-made sauce, t (198) = 3.438, $p < 0.001$. Similarly, participants who were asked to imagine a herbal scent of mixed herbs (M = 2.67, SD = 2.299) compared to the unscented control group (M = 3.44, SD = 2.304) were more willing to buy fresh and raw ingredients to make their own beef stew versus buying a pre-prepared stew, t (198) = −2.362, p =.019.

Home-cooking concept. We performed a mediation analysis using bootstrapped samples (5,000) procedure with SPSS Process Macro Model 4 (Hayes, 2013). An indirect effect was revealed, with the effect of an herbal scent on pasta sauce choice being mediated by more thoughts related to home-cooking (B = .1417, SE = .0758, CI_{95} = [0.0171, 0.1395]). This result supports H2 and shows a mediation effect because the CI excludes zero. An additional mediation analysis test following the same procedures revealed an indirect effect, with the effect of an herbal scent on beef stew choice likewise being mediated by an increase in thoughts related to home cooking (B = .1417, SE = .0758, CI_{95} = [0.0171, 0.3096]). This result again supports for H2 and shows a mediation effect because the CI excludes zero.

Alternative explanation. We performed a mediation test using bootstrapped samples (5,000) procedure with Model 4 (Hayes, 2013). An indirect effect was not revealed, with the effect of an herbal scent on pasta sauce choice not being mediated by feelings of having a rewarding experience (B = .1243, SE = .0897, CI_{95} = [-0.0360, 0.3169]). These results lend further support H2, as the CI includes zero, showing that perceived reward is not an underlying reason for the main effect.

5.3. Discussion

Study 3 makes two important contributions. First, it provides further support for our prediction that an herbal scent leads to more wholesome food choices. Participants who imagined the scent of mixed herbs indicated a greater preference for fresher, raw, and wholefood ingredients to cook food at home in comparison to the unscented control. These foods are wholesome, as ingredients that are used to make a meal at home are considered healthier than shelf-stable options or processed foods, which can have higher levels of sodium, sugar, oils, fat and/or preservatives (Monteiro et al., 2019). This research aligns and extends findings from Esteky (2021), Gaillet et al. (2013) and Gaillet-Torrent et al. (2014), showing that not only can fruit scents or natural scents influence food choices via activated concepts associated with a prime, but so can herbal

scents.

Second, we show support for H_2. Results show that an herbal scent encountered in a congruent store context heightens semantic associations to home cooking, which in turn drive consumers to select more congruent wholesome food. This study not only gives support for H_1, in that, an herbal scent can lead to wholesome food choices, but it also demonstrates the underlying process mechanisms. In this mechanism, we show support for priming of semantic associations (Esteky, 2021; Leenders et al., 2019; Orth and Bourrain, 2008).

6. General discussion

The smell of herbs is a scent many consumers are familiar with—used for centuries in global cuisines and everyday home cooking to enhance the flavor of food (Stefanaki and van Andel, 2021; Tapsell et al., 2006). Such repeated exposure to a scent and the accompanying experiences can form strong associations in memory (Orth and Bourrain, 2008), which the present studies show can help drive choice of particular kinds of food choice in retail settings. That's because the mere act of smelling or even imagining an herbal scent serves as an environmental cue to stimulate cognitions from commonplace consumer experience of cooking and/or eating a home-cooked meal prepared from fresh ingredients. This home-cooking association, when activated via a sensory cue in a congruent setting such as the produce section within a retail store (Leenders et al., 2019), then stimulates desire to choose and purchase associated whole and less processed foods. In this way, we show that adding the smell of an herbal scent such as mixed herbs to a supermarket environment can elicit thoughts of home-cooking, priming greater choice and purchase of congruent wholesome foods to make a meal at home.

6.1. Theoretical contribution

We build evidence for the model of priming effects in which culinary herbal scents in a congruent food setting directly cue related food uptake (Esteky, 2021; Gaillet et al., 2013; Gaillet-Torrent et al., 2014; Leenders et al., 2019; Lefebvre and Biswas, 2019). Although prior work has examined the effects of scent on pre-consumption responses, food choice (Gaillet et al., 2013; Gaillet-Torrent et al., 2014; Lefebvre and Biswas, 2019; Ramaekers et al., 2014, 2016; Zoon et al., 2016) and retailer sales (Biswas and Szocs, 2019; Herrmann et al., 2012), the present research is the first to examine the effects of herbal scents on preferences for wholesome food options and baskets of food, along with sales. More broadly, this work has important implications for research on retail atmospherics and its influence on food choice (i.e., Biswas and Szocs, 2019; Biswas and Szocs, 2019; Chae et al., 2023; Esteky, 2021; Lefebvre and Biswas, 2019), as well as sensory marketing and olfaction research (Biswas and Szocs, 2019; Krishna, 2012; Madzharov et al., 2015).

Past work on ambient scent has largely focused on the mediating role of implicit and semantic associations (Gaillet et al., 2013; Leenders et al., 2019; Lefebvre and Biswas, 2019), the appetitive nature of the cued food and cross-modal sensory compensation (Biswas and Szocs, 2019) in driving food choices. These studies did not account for the ability of an ambient food scent to evoke semantic associations related to the concept of home cooking and home-cooked meals. Consistent with congruency theory (Mandler, 1982) and semantic congruency (Krishna et al., 2010), the current studies highlight the importance of previously learned associations in memory (Orth and Bourrain, 2008) and meal-related congruent responses consumers have with a culinary herbal scent such as mixed herbs and the link to semantic associations of home-cooking. Prior research shows that when odors are perceived, semantic associations between the odor and previously stored sensory knowledge can become activated, and subsequently influence behaviour (Gaillet-Torrent et al., 2014; Holland et al., 2005; Leenders et al., 2019; Spangenberg et al., 2006). We add to this work by linking scent to wholesome food choices via a home-cooking concept. The link to past sensory knowledge associated with home-cooked meals can be used as a driver to nudge consumers towards foods that are better for their health.

6.2. Managerial implications

Consumer needs and consumption habits are rapidly evolving, with preferences for wholesome foods becoming more apparent. The supermarket of the future will continue to prioritize fresh produce, meat, dairy, whole foods, and plant-based alternatives to reflect lifestyle preferences of consumers (Deloitte, 2022). Our investigation highlights the relationship between an herbal scent and wholesome food choice as one-way retailers can prioritize and highlight fresh, minimally processed foods for consumers to reflect tastes and lifestyle preferences. The implementation of an ambient scent in a retail food store is a relatively low cost, effective mechanism for encouraging health-related behaviours. This can help retailers achieve corporate social responsibility outcomes, as well as increase profits by targeting fresh food departments. Pricing structures in supermarkets for fresh food departments compared to grocery departments have higher wastage allowances, meaning larger profit margins. The higher the sales in fresh food departments, the less wastage, and the higher the profits generated by the supermarket. These factors can make it desirable for supermarket retailers to diffuse herbal scents in their fresh food departments.

As the metaverse and virtual retailing experiences continue to evolve, understanding other sensory cues beyond audio and visual become important in enhancing multisensory digital experiences (Flavián et al., 2021). Recent research has begun exploring the influence of real or imagined scent on digital experiences and downstream behavioural reaction (Cowan et al., 2023; Flavián et al., 2021). Our work adds to and extends this literature stream by focusing on food choices and purchasing but is also useful to retailers considering how scent might be integrated into the digital experiences for consumers of tomorrow.

6.3. Limitations and future research

One limitation of this research is an exclusive focus on mixed herbs (i.e., thyme, rosemary, oregano, and basil) as the culinary herbal scent. Future research could investigate other types of herb and spice scents such as lemongrass, ginger, paprika, cumin, turmeric, cardamon and coriander, to determine whether the effect extends to other culinary herbal scents. Furthermore, although we investigate wholesome food choices in supermarket settings, it is possible herbal scents can inspire uptake of wholesome choices beyond food settings. Considering that wholesome choices have clear impacts on health and well-being, how might other types of herbal scents such as lemongrass, ginger, and/or sage impact wholesome choices in other contexts such as spa settings and clothing stores? With associations to healthiness and/or nature created, it is possible priming herbal scents could drive greater purchasing of exercise clothing or encourage people to sign up for exercise classes— such as in a Lululemon store, where yoga classes are on offer (Lululemon and Yoga, 2023). As scent's impact on wholesome choice is a largely unexplored area of consumer behaviour, marketing, and retail research, we hope these findings will inspire ideas for future research.

Though prior research shows that merely imagining an odor as opposed to experiencing it can have similar effects on consumer behaviour (Krishna et al., 2014), we acknowledge that more support is needed to generalize results and add further evidence to the underlying process model shown in study 3. Future research could consider whether (in)congruence is a potential boundary condition. Restraint eaters can also have a heightened sensitivity to food cues (Chae et al., 2023; Luomala et al., 2018), which warrants examination of individual differences in food choices as a possible moderating variable. Additional mediators should be tested such as associations with freshness, naturalness, indulgence, healthiness, arousal, and relaxation, to name a few. We also concede that the mixed herbs we test here are associated largely with

Western dishes and cooking (Jamieoliver.com, 2016), which indicates meal preparation with different herb and spice scents must be investigated in other cultural settings to determine the generalizability of this effect.

Consumers are more likely to select more wholesome, raw and fresh ingredients and less processed foods when a culinary herbal scent such as mixed herbs is pumped into a retail environment. As a relatively cheap and feasible sensory marketing and retail atmospheric tactic, retailers can employ subtle cues to highlight healthier options for consumers, provide beneficial impact for consumer health and well-being, and to improve bottom lines.

CRediT authorship contribution statement

Megan Phillips: Writing – review & editing, Writing – original draft, Visualization, Validation, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Sommer Kapitan:** Writing – review & editing, Writing – original draft, Supervision, Resources, Methodology, Formal analysis, Data curation, Conceptualization. **Elaine Rush:** Writing – original draft, Supervision, Methodology, Conceptualization.

Declaration of competing interest

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Data availability

Data will be made available on request.

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Appendix 1. Study 1 coding of food items

Example of a more wholesome basket.

Item purchased	Total Cost	Score
Shaved Parmesan Cheese	$4.99	24
Strawberries Punnett	$3.99	−8
Lite Greek Style Natural Yoghurt	$6.49	3
Cucumbers green	$1.49	−8
Original Milk	$4.45	1
Sweetcorn	$0.99	−11
Sweetcorn	$0.99	−11
Broccoli	$1.79	−13
Fresh Capsicum yellow	$1.99	−8
Size 7 Free Range Eggs 12 pack	$7.09	0
Avocado Hass	$1.99	−8
6 Apples Royal Gala	$1.79	−8
Lamb mince premium	$9.00	1
Herbal tea pure peppermint	$4.59	0
Alpine pork sausages	$7.49	13
Peanut butter crunchy	$4.55	15
Sliced bread wholemeal and grain sandwhich	$2.59	−1
Pita Bread	$2.29	2
Medium wholegrain brown rice	$2.99	−4
6 tomatoes truss vine	$1.79	−9
1 onions red peeled	$0.50	−8
4 carrots	$0.92	−9
Courgette	$4.99	−10
Total basket spend and NPI score	**$79.74**	**−57**
DV_wholesome amount (-57/23)	**−2.478**	
DV_wholesome spend (-57/79.74)	**−0.715**	
DV_wholefoods amount (14/23)	**0.601**	
DV_wholefoods spend (14/79.94)	**0.175**	

Example of a less wholesome basket.

Item purchased	Total Cost	Score
2 Apples Royal Gala	$0.60	−8
Lite Milk	$4.45	1
Nutella	$9.99	25
Wheatmeal bread	$1.48	−3
Jaffa Thins	$3.49	25
Corn chips jalapeno	$3.69	17
Lemon and ginger green tea bags	$3.35	0
Wildberry sorbet	$4.79	5
3 Bananas yellow	$0.90	−5
1 Apples Royal Gala	$0.30	−8

(*continued on next page*)

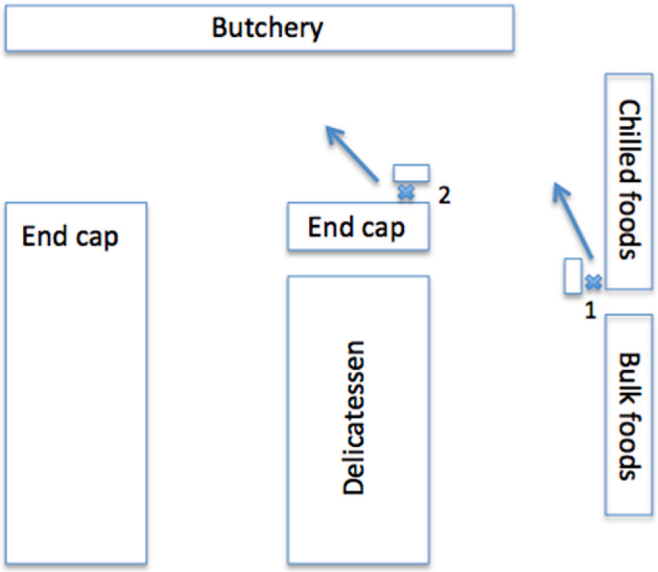
(*continued*)

Item purchased	Total Cost	Score
Garlic bread	$3.79	13
Extra dark chocolate	$3.99	24
Salsa medium	$2.99	−1
Cheese slices colby	$4.15	32
Total basket spend and NPI score	**$47.96**	**117**
DV_wholesome amount (117/14)	**8.357**	
DV_wholesome spend (117/47.96)	**2.440**	
DV_wholefoods amount (3/14)	**0.214**	
DV_wholefoods spend (3/47.96)	**0.063**	

Appendix 2. Scent Description

Participant Number	Scent type	Scent description	Coding
1	Herbal	Medicinal and herbal w/hints of garlic or seasoning	1 = herbal
2	Herbal	Calm, natural, herby	1 = herbal
3	Herbal	Smells like tiger balm (those medicinal lip balms from foreign countries)	1 = herbal
4	Herbal	Herby and a garden smell. Smells familiar	1 = herbal
5	Herbal	Lemons	0 = non-herbal
6	Herbal	Fruity spice	1 = herbal
7	Herbal	Herbs, spices, meat	1 = herbal
8	Herbal	Strong, organic, minty	1 = herbal
9	Herbal	The scent kind of smells like mint or like thyme	1 = herbal
10	Herbal	Earthy, oregano, herbal medicine	1 = herbal
11	Herbal	A little bit peppery and slightly sharp, but not completely overwhelming	1 = herbal
12	Herbal	Medicine ointment type scent quite strong	1 = herbal
13	Herbal	Smells bitter and acidic	0 = non-herbal
14	Herbal	Minty and dirty	1 = herbal
15	Herbal	Cinnamon green	1 = herbal
16	Herbal	Sweet but leaves a smoky taste behind eucalyptus	1 = herbal
17	Herbal	Smell like refreshing but also more like spices or cooking ingredients	1 = herbal
18	Herbal	Mentholly, slightly chemically, bitterish, ammonia after smell	1 = herbal
19	Herbal	Not a good smell	0 = non-herbal
20	Herbal	Earthy smell, herb smell	1 = herbal
21	Herbal	Herbal	1 = herbal
22	Non-herbal	Chocolate, sweet but also a little fresh	0 = non-herbal
23	Non-herbal	Vanilla, slight caramel undertone	0 = non-herbal
24	Non-herbal	Semi-sweet, coffee like drink – Starbucks	0 = non-herbal
25	Non-herbal	Espresso martini – vanilla, coffee, hazelnut	0 = non-herbal
26	Non-herbal	Spicy	1 = herbal
27	Non-herbal	Like vanilla	0 = non-herbal
28	Non-herbal	Smells sweet like an almond/hazelnut vanilla smell with a hint of sandalwood	0 = non-herbal
29	Non-herbal	Kind of like a bad spice for cooking	1 = herbal
30	Non-herbal	A mix of freshly baked pastry and old people. A little like a protein snack	0 = non-herbal
31	Non-herbal	Thick, sweet, vanilla-based, hints of a spice	1 = herbal
32	Non-herbal	Smells sweet like caramel but also smells a bit like popcorn	0 = non-herbal
33	Non-herbal	Smells like woody	0 = non-herbal
34	Non-herbal	Pleasant, yummy, sweet, caramelised	0 = non-herbal
35	Non-herbal	Sweet, vanilla, old socks, low lying flat, round	0 = non-herbal
36	Non-herbal	Expired coffee flavour candy, old can	0 = non-herbal
37	Non-herbal	It smells like the croissant with cheese	0 = non-herbal
38	Non-herbal	Too heavy a top to make the taste peanut	0 = non-herbal
39	Non-herbal	It has a peculiar smell, a little bit of vanilla but stronger than vanilla	0 = non-herbal
40	Non-herbal	Sweet, thick	0 = non-herbal
41	Non-herbal	Buttery, sweet, very slightly vanilla, few instances of artificial flavours	0 = non-herbal
42	Non-herbal	Sweet with a touch of vanilla extract	0 = non-herbal

Appendix 3. Scent machine positions in field study store



Position and direction of scent dispersion of two scent machines.

Photo of scent machine number 1.

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